

Aviation Safety, an Introduction

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Air transport will continue to grow. It has a good relative safety record but public perception focuses on total accidents rather than relative safety. This has led to the setting of ambitious new safety targets for air transport, whose attainment will require improved knowledge of causes of accidents and better understanding of the effects of new technologies and procedures. Human factors and operational environments are key elements while aircraft design, construction and maintenance, together with ATC operations and accident mitigation, also play important roles. During the Aerodays a variety of projects relating to these matters were presented.

In order to satisfy the needs of the modern citizen, air transport capacity will have to grow. A growth rate of - on average - 5% per year, during the next 20 years is expected to be needed to satisfy the demand for passenger air travel. This will result in at least twice as many aircraft and aircraft movements in the global air transport system. It is expected that new, bigger, aeroplanes will be used to accommodate the growth in air transport.

At the same time, society demands that the air transport system will generate less noise, especially in the vicinity of airports, and pollution- both at airports and in the global atmosphere. And the public acceptance of unsafety in air transport is decreasing: in fact, a zero fatal accident rate is requested from our mature industry, even though the air transport passenger volume will nearly triple by 2020.

The air transport sector has set new safety objectives: in fact the Group of Personalities report calls for a fivefold reduction of the average accidents rate of global operators by 2020.

To enable the air traffic to grow, new products will be introduced and new solutions will have to be introduced. There will be new benefits but also new risks attached to them.

causal relationships has shown that there are a limited number of crucial factors that contribute to accidents (see figure 3). During the Aerodays, Mr. Roelen of NLR presented the DESIRE-project. The purpose of the project is to identify areas for safety improvements by investigating the causal structure of accidents. By combining this with the costs associated with accidents (liability claims, aircraft loss etc) a cost - benefit approach towards aviation safety is feasible. This approach will determine the most cost-effective measures to increase aviation safety.

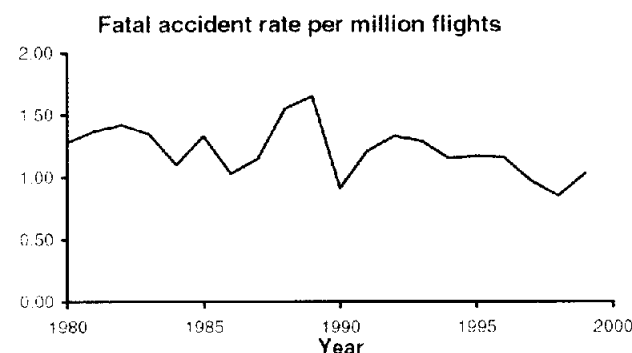


Figure 1. Relative worldwide commercial aviation safety levels.

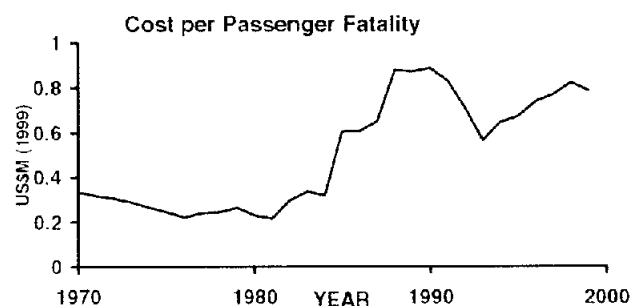


Figure 2. Development in passenger liability costs in million US\$.

Risks in civil aviation

Based on statistical data on fatal accidents, it can be concluded that civil aviation is very safe. Relative safety levels have been fairly constant over the past 15 years as illustrated in figure 1.

As traffic volumes are increasing, the absolute number of accidents increases at the same rate. This not only results in a public image of unsafety, which could influence the demand for air transport. It also results in a substantial increase in liability claims, which ultimately will influence the cost of air travel (see figure 2).

System monitoring

Statistical data analysis provides a means to understand the causes of accidents. Although, in most cases, accidents are the combined result of several causes and conditions, analysis of

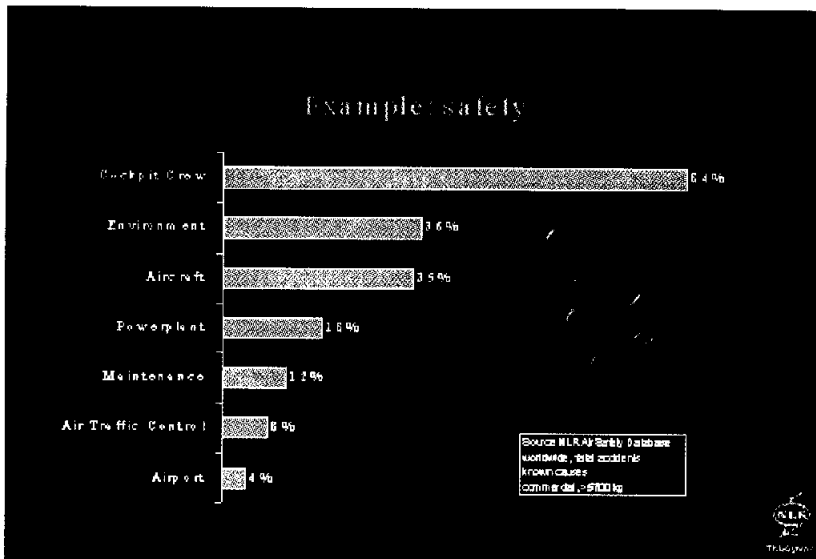


Figure 3. Contributing factors to fatal accidents.

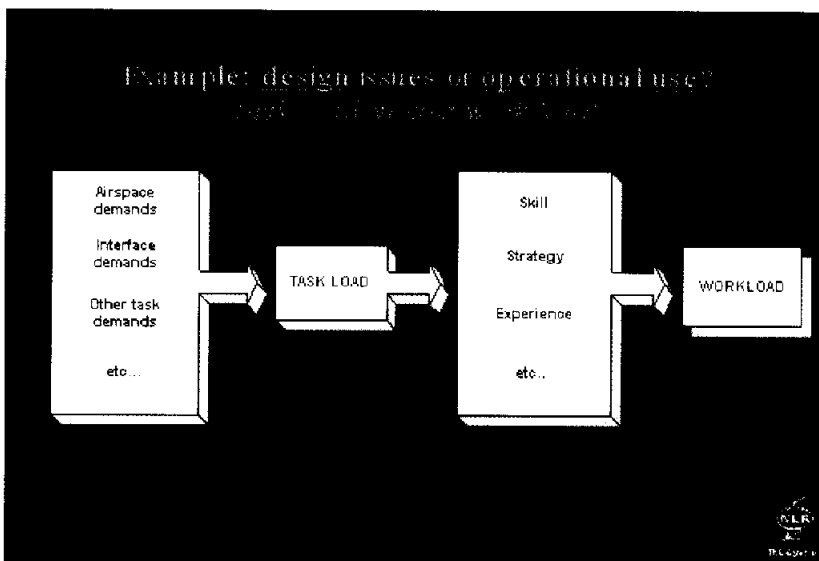


Figure 4. Task load versus workload issues.

As accidents are - in most cases - the result of a chain of events, several projects to identify these events in routine operations are underway. The aim is to identify day-to-day incidents, to learn from these and to prevent incidents becoming potential accidents. An approach is to create 'missing links' in a chain of incidents that could lead to accidents.

Systems from the manufacturing industry (like Airbus - LOMS) and the airline industry (like BA's - BASIS) monitor daily operations through flight data recorder data analysis. A similar system has been developed to monitor daily ATC-operations. During the Aerodays, Mr. T. Joyce of Eurocontrol explained the ASMT tool, which helps to monitor daily ATC-operations to identify and avoid incidents.

The system will automatically detect, classify, store, alert and assess safety occurrences. The ASMT tool is still in a pre-operational phase. It will also be used as an important training tool for future controllers.

Statistical analysis cannot take into account the impact of future systems on aviation safety. Therefore, modelling must be used to predict the safety effects of new systems and procedures on target levels of safety.

The human factor

The human factor plays an important role in aviation accidents and incidents. During the Aerodays, the need for a 'human centred approach' in system design and operations was highlighted. Introducing new equipment without fully taking into account the Human Machine Interface (HMI) will lead to increased error levels, increased training requirements and resistance to use of new technology. Furthermore, new products will not be used up to their full potential.

One element in the HMI issue is operator workload, which is not only determined by the taskload resulting from system factors: workload is also determined by the abilities, experience and working environment of the human operator. These elements are vital issues in a human-centred approach towards system design (see figure 4).

A human-centred approach should take into account user behaviour by using cognitive engineering. The effectiveness of the HMI should be measured as was explained by Mr. B. Hilburn of NLR. In the VINTHIEC-projects, which are supported by the Commission, eye point of gaze measurements in combination with heart rate, pupil size, and respiration measurements, provide data on operator performance and workload.

One of the EU projects in which the VINTHIEC-approach was used is the DIVA-project, presented by Mr. D. Ferro of EADS.

A report is included in the proceedings. A new application of cognitive engineering is in the COCOPAN-project which - as reported by Mr. G. Coussot (GIFAS) - aims at the development of a new generation of overhead cockpit panels.

The human factor is not only present in the air or in ATM, but also in maintenance. In these proceedings a contribution by Mr. N. McDonald (Trinity) on the ADAMS-project is presented.

The operational environment

Aircraft operate in a harsh environment. Weather conditions often contribute to aviation unsafety. Systems such as

advanced onboard warning systems, datalink communication, satellite navigation and surveillance help the crew to maintain situational awareness, and prevent un-controlled flight.

European research on external hazards - the understanding of the phenomena, the prediction, detection, warning and avoidance - is supported by a network of specialists: EXTHAZ. Mr. I. Uhlig of EADS provided a presentation. During the conference, European projects dealing with electromagnetic hazards and lightning protection were presented as well as projects on aircraft icing. A contribution by Mr. A Amendola (CIRA) on icing issues is included.

Wake vortices are not only an air transport safety issue; the wake vortex of aircraft also has a decisive impact on the capacity of the air transport system. In Europe, substantial efforts are being made to better understand, avoid, detect and reduce wake vortex phenomena. An overview paper on European activities is provided in these proceedings. The WAKENET-network as presented by Mr. K. Hünecke of EADS brings together the specialists in Europe. Amongst these specialists are Mr. A. de Bruin (NLR) and Ms. C. Bruel (THALES), who reported on the progress in the S-WAKE and M-FLAME projects.

The wake vortex phenomena are studied not only on a European scale. A close relationship has been developed with specialists in Russia through a number of projects, as explained by Mr. V.V. Vyshinsky (TsAGI) in these proceedings.

Aircraft, engine and maintenance safety issues

Advanced aircraft systems and structures can help to prevent accidents and to make accidents survivable. During previous Aerodays, progress on European developments in pro-active warning systems and advanced integrated avionics suites that

provide increased situational awareness, i.e. through sensor fusion, were highlighted. During the latest Aerodays, the focus was on fire/smoke detection in the FIREDETEx-project. The report of Mr. K.M. Kallergis (EADS) is reprinted in these proceedings. The proceedings also contain a contributions by Mr. M. Al-Khalil (BAe Airbus) et al on the CRASURV project, as well as two papers on composite structures. Also, a number of projects related to increasing engine and engine component safety were presented.

Finally, the relationship between safety and maintenance was discussed. The presentation of Ms. Marioli-Riga (Hellenic-Aerospace Industry) on composite repairs of metallic structures (COMPRES) is reprinted here.

Conclusion

Presentations at the Aerodays of 2001 have demonstrated that there are high quality European initiatives that will contribute substantially to the goals set by the Group of Personalities to increase safety in commercial aviation. It is expected that the current and future European research in safety related issues, including supporting research to improve certification processes, will enable the long-term safety goals to be met. The contributions in these proceedings will certainly be a proof of the excellent expertise and capabilities in the domain. ■

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